KEPCO POWER SUPPLY news

Latest information on the development and application of Voltage/Current Regulated Power Supplies.

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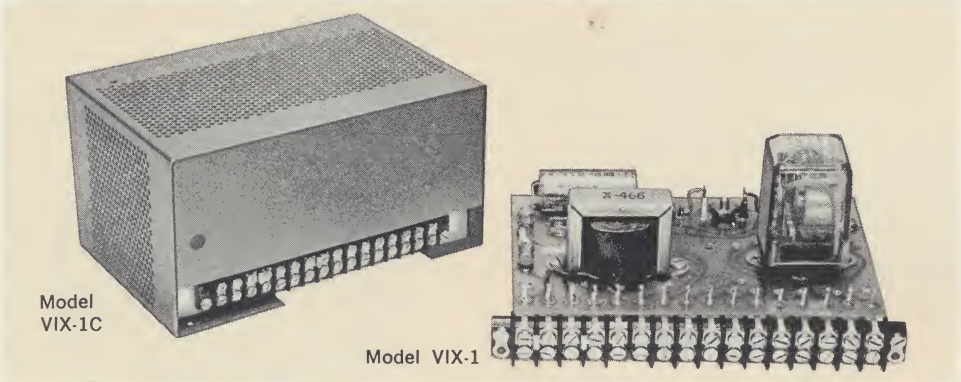
KEPCO APPLICATIONS EQUIPMENT

BROADENS FUNCTIONAL CAPABILITIES OF REGULATED POWER SUPPLIES



Model VIX-1C

Model VIX-1

PREVIEWED AT WESCON

Kepco is showing a number of new products at Wescon in their booths Nos. 1412 and 1413. These new products include new concepts in regulated power supplies and new applications assistance devices.

Manufacturers of electronic devices and systems will find the new modular regulated power supplies unique and interesting. Two new modular design groups, the PAX and PRM, are being shown. The PAX design group power supplies are line and load regulated and fully programmable. Electrically and mechanically very versatile these modules have a wide range of applicability. The PRM design group provides fixed "battery" voltage, line regulated power. More watts per cubic inch, more watts per pound and more watts per dollar are possible in the PRM design which is based on the patented Flux-O-Tran line-regulating transformer.

Also to be shown are two experience-proved design groups of power supplies having new capabilities. The SM Design Group is being presented with newly improved characteristics and at new low prices. These 15 different power supplies, ranging from 0-14 volts at 0-7 amperes to 0-325 volts at 0-2 amperes with 0.01% line and 0.05% load regulation, feature the newly patented Flux-O-Tran line regulating transformer and the Kepco Bridge post regulator. The second of the exeperience proved groups to be shown is the Hybrid HB Design Group of 6 different units. Previously available at 0-325 volts at 0-200 to 0-800 milli-

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VIX RELAY – MODEL VIX - 1C

Kepco regulated power supplies which are both voltage and current regulating with automatic cross-over comprising the CK and KS Design Groups are equipped with VIX indicators and with VIX signalling circuits. The VIX capability includes a pair of lamps, one of which lights when the power supply is operating in its voltage regulating mode and other of which lights when the power supply is operating in its current regulating mode. A voltage from the switching circuit which actuates these mode indicating lights is available for external use. The externally available voltage is one which provides an 8 volt signal of one polarity for voltage mode and the opposite polarity for current mode.

Audible or visual remote signalling or automatic switching functions carried out at the cross-over point generally require a certain amount of power. For this reason the Model VIX-1C Relay has been made available. This relay includes a transistor amplifier, power supply and three pole double throw relay. When the input is coupled to the VIX terminals of a CK or KS regulated power supply, the output will switch any three wire circuit carrying up to 10 amperes at 115 volts AC or 5 amperes at 230 volts AC.

Applications include remote audible or visible signals indicating cross-over in the power supply. Monitoring for changes in circuit conditions as in life

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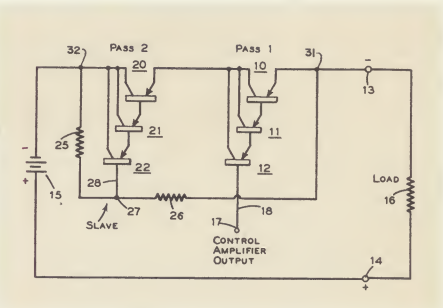
KEPCO PATENT AWARD

Higher output voltage from transistorized regulated power supplies are possible with the Kepco slave pass transistor circuit. The novelty and utility of this circuit has been recognized by the issuance of U.S. Patent No. 3,128,-423 on April 7, 1964.

Regulated power supplies commonly use power transistors in a series pass circuit to regulate and to control the output voltage or current. In such power supplies designed for full range output control, i.e. for control from full rated output voltage down to zero, the series pass transistor must at times support the maximum voltage of the supply. Full range controlled power supplies providing voltages in excess of available transistor voltage ratings can be built with highly reliable characteristics by utilizing additional series pass transistors in series connection (see the drawing). The voltage being absorbed in the series control circuit is divided among the series transistors. For maximum efficiency and reliability of such a system the division of the voltage drop among the series transistors should be substantially equal and the dividing means should draw comparatively little current. The patent covers a reliable and efficient slave transistor circuit and one which is used to advantage in a number of Kepco regulated power supplies.



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NEW VOLTAGE LIMITING CIRCUIT

APPLICABLE TO ALL KEPCO BRIDGE CONTROLLED REGULATED POWER SUPPLIES

A new circuit has been developed which is simple to apply to Kepco Bridge controlled power supplies to limit the maximum programmable voltage in either current or voltage regulating modes. An inexpensive, low power zener diode is all that is required even for high power supplies.

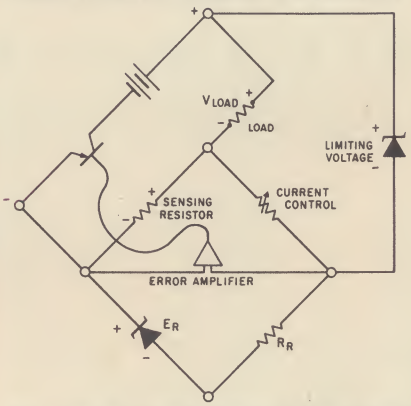
Some form of overload (voltage) limiting for power supply operation in the current regulation mode is a desirable feature. Adjustable limiting is, of course, provided in all automatic crossover power supplies where the voltage control setting serves as the upper limit to the voltage compliance. When external sensing is used to generate current regulation, or non-automatic crossover power supplies are set up for current regulation, voltage limiting must be provided by external means.

A current regulator, in the ideal sense, will treat any open circuit as if it were an overload. The terminal voltage will rise toward infinity as the supply tries to maintain its pre-set current through the infinite load resistance. Actually, of course, the "infinite" voltage is limited to the maximum available raw DC that the transformer-rectifiers can generate. This is dependent on line voltage, but is usually about 150% of the supply's regulated output rating (or band switch position in an HB model). When the output voltage reaches this maximum, it *is* limited, and so the current cannot be maintained through the load. This constitutes the overload condition for a current regulator.

It may be desirable to introduce limiting in such power supplies so that the limiting point would be independent of line voltage or would be at a lower value to protect a load. Such limiting is easily introduced by means of appropriate zener diodes. A zener diode of appropriate voltage breakdown rating would be connected across the power supply's *Remote Programming* terminals, found at the rear of all such power supplies.

When the compliance voltage (output voltage) of the power supply is less than the zener breakdown rating, the diode does not conduct and has no effect upon the power supply's performance. When the voltage tries to exceed the zener rating, the diode will conduct causing the voltage to be limited to the zener rating.

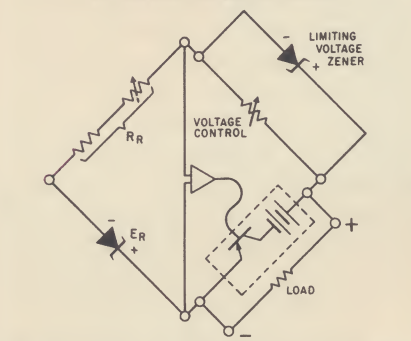
VOLTAGE LIMITING FOR CURRENT MODE OPERATION
WHERE AUTOMATIC CROSSOVER IS INAPPLICABLE



NOTE: LIMITING VOLTAGE EQUALS THE LOAD VOLTAGE PLUS THE DROP ACROSS THE SENSING RESISTOR.

The maximum zener current would equal the rated bridge current of the power supply in question. 1 ma, 3.3 ma or 10 ma are typical values (control ratios of: 1000 ohms/volt, 300 ohms/volt and 100 ohms/volt respectively). This light current permits the use of relatively small inexpensive zeners even though the current rating of the power supply may be dozens of amperes. Since zeners can be obtained in a variety of voltage breakdown ratings, and can be series connected if desired, this method offers a quick and inexpensive way of obtaining fixed voltage limiting. Because the zener "knee" is not likely to be particularly sharp at the light bridge current, it is recommended that the zener be selected for at least 10% excess voltage above the maximum desired compliance.

VOLTAGE LIMITING IN VOLTAGE MODE OPERATION
ALL-TRANSISTOR MODEL SHOWN



MAXIMUM OUTPUT VOLTAGE EQUALS ZENER VOLTAGE OF LIMITING DIODE.

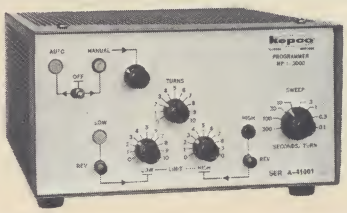
It should be noted that voltage limiting is not restricted to current regulators, but can be applied in the same way as set forth above to limit the maximum programmable voltage from a voltage regulated power supply.

VIX RELAY

Continued from Page 1—Col. 2

testing, etc. are suggested. The control function may be used to turn on or turn off equipment in response to circuit changes. Automation with the relay may be carried out, as for example, capacitor forming or charging systems can be connected to switch at the crossover point with an automatic function which removes one capacitor from the circuit and connects another. Many other applications will be possible in automated or semi-automated processing or controlling.

MOTORIZED PROGRAMMER MODEL MP-1-3000



Most Kepco regulated power supplies are programmable by means of externally connected resistance. When such a power supply is programmed by resistance, its output voltage or current is made to follow a similar function. There are many applications for a voltage or current which can be programmed in a predetermined manner. Kepco has now provided a new programming device consisting of a motor driven variable resistor suited for use where low frequency programmed voltage or current is needed.

The Model MP-1-3000 motorized programmer consists of three basic components; a synchronous motor, a multi-speed reversible gear box, and a 10-turn servo-mount potentiometer. The synchronous motor provides a constant speed drive so that repeated cycles of operation are equally timed. The gear box provides 8 selectable ratios in geometric progression from 0.1 second per revolution (1 second for 10 turns) to 300 seconds per revolution (3000 seconds for 10 turns). The flexibility of the system is carried to its logical conclusion by permitting customer specification of the potentiometer in values from 10 ohms to 125,000 ohms.

The programmed voltage or current is varied to increase and decrease at a constant rate providing a triangular wave shape.

Adjustable limits use the full 10-turn excursion of the potentiometer or only a selected portion. Since the upper and lower limits are independently adjus-

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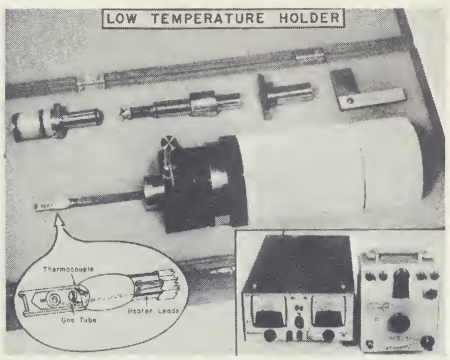
ELECTRON MICROSCOPE CAPABILITIES ARE EXTENDED WITH KEPCO POWER SUPPLIES

APPLICATION NOTE*

Ladd Research Industries of Burltington, Vermont are engaged in the field of electron microscopy. They design and manufacture many unique accessories for electron microscopes which greatly expand the capability and usefulness of these research instruments. One of these accessories is illustrated in the picture, a low temperature specimen holder for the electron microscope.

Basically, this holder allows the examination of a specimen at magnifications of between 10,000 and 100,000 diameters at temperatures which can be very accurately controlled from room ambient to minus 190°C.

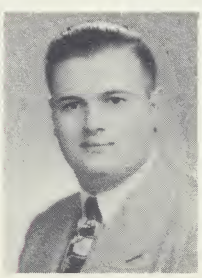
The specimen is secured at the tip of the holder. The holder is then inserted in the electron microscope in such a manner that all movement is completely eliminated; this requirement becomes obvious when we realize that a magnification of up to 100,000 diameters is often necessary. Temperature is then lowered by the introduction of liquid nitrogen at the larger end of the holder. (See Photo).



The introduction of this liquid immediately takes the specimen down to a temperature of minus 190°C (–310°F). A constant, well regulated, current from a Kepco Model CK 2-8M regulated power supply is then applied to the heater leads which terminate in a heating coil near the tip of the holder. The temperature of the specimen can now be very accurately controlled from between room ambient and –190°C by changing the amount of constant current supplied by the Model CK 2-8M regulated power supply through the heating coil. The heat produced is actually used to counteract the low temperature produced by the liquid nitrogen in order that temperature control might be possible. The specimen temperature is measured making use of a Leeds & Northrup Temperature Potentiometer which is connected to the thermocouple shown in the photograph. Temperature regulation, as can be appreciated, is only as good as the source of constant current supplied through the heater. Mr. Ladd states that resolution and regulation offered by our Model CK 2-8M has been responsible for giving science an electron microscope low temperature holder with a very high degree of temperature accuracy repeatability.

Mr. Ladd required a constant current power supply which was continuously variable and could be adjusted from the front panel. Ladd purchased six (6) Model 6901 prototypes of what Kepco now offers as the Model CK 2-8M. No other power supply manufacturer was able to satisfy Mr. Ladd's requirements with a standard offering at that time. ANOTHER KEPCO FIRST!

A high temperature specimen holder is also included in the Ladd Line of accessory equipment. This holder likewise uses a Kepco CK 2-8M power supply to provide current to a 100 mesh molybdenum 1/16" wide, 1/4" long and .001" in thickness. This grid, resistance heated, supports and heats the specimen being examined in the electron microscope Temperatures of over 1500°C (2700°F) have been obtained. Here again elimination of thermal drift of the specimen at high magnification requires an extremely stable constant current power supply. The Kepco supply has fulfilled these stringent requirements.



The above Application Note was sent in by Mr. Richard Sabine of Ray Perron & Company, Inc., Manchester, N. H. Kepco representatives in New England. This application originated at Ladd Research Industries, Inc., of Burlington, Vermont and serves to illustrate one of many unusual and unexpected applications to which Kepco regulated power supplies are constantly being put.

Kepco is pleased to publish notes, circuits and suggestions contributed by our customers. Publication does not, however, constitute endorsement, and in fact, other circuits have been developed and will be published in future issues.

GLOSSARY OF POWER SUPPLY TERMS

In a rapidly evolving technology the language of that technology changes to keep pace. The following terms and their definitions have either come into use in the last year or have become subject to some new interpretation.

ACCURACY:

Accuracy, used as a specification for the output voltage of fixed voltage power supplies refers to the absolute voltage tolerance with respect to the stated nominal output.

BRIDGE CURENT:

The circulating control current in the comparison bridge; bridge current equals the reference voltage divided by the reference resistor. Typical values are 1 ma, 3.3 ma and 10 ma corresponding to control ratios of 1000 ohms/volt, 300 ohms /volt and 100 ohms/volt respecively.

CALIBRATION, PROGRAMMING:

Calibration with reference to power supply programming describes the adjustment of the control bridge current to calibrate the programming ratio in ohms per volt. Many programmable supplies incorporate a "calibrate" control as part of the reference resistor which performs this adjustment.

COMPLIANCE EXTENSION:

A form of master/slave interconnection of two or more current regulated supplies to increase their compliance voltage range through series connection.

COMPLIANCE VOLTAGE:

The output voltage of a DC power supply operating in constant current mode. The compliance range is the range of voltages needed to sustain a given value of constant current throughout a range of load resistances.

"DELTA", MINIMUM

A qualifier, often appended to a percentage specification to describe that specification when the parameter in question is a variable, and particularly when that variable may approach zero. The qualifier is often known as the "minimum delta V", or "minimum delta I" as the case may be.

SHUNT REGULATOR

A device placed across the output which controls the current through a series dropping resistance to maintain a constant voltage or current output.

PREVIEWED AT WESCON

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amperes, several new models have been added. A new pricing structure now makes these power supplies of a greater value than ever before, featuring regulation and stability improvement from 0.1% to 0.01% and the addition of a 10-turn vernier voltage control.

The ABC Design Group of half rack power supplies will be shown completely equipped with 10 turn potentiometer voltage controls for the best regulation and resolution of any power supply in its class and all at no increase in price. Application oriented devices to be shown include a number of products to enhance the value of Kepco power supplies as functional components.

The Model MP 1-3000 motorized programmer is a mechanically driven resistance programmer suitable for use with any Kepco programmable power supply.

The Model FG-100 Function Generator is a precision, slow speed, triangular waveform generator capable of generating repetitive ramp functions for voltage or current programming of voltage or current programmable regulated power supplies. Great flexibility is provided by separately adjustable, high and low limits, which periodically reverse the direction of the programming signal. The rise and fall rates are separately adjustable or can be controlled symmetrically with a single control.

The Model 64 Isolation Enclosure provides up to 10,000 volts DC isolation for the chassis of any half-rack sized power supply or instrument. Specifically designed to accommodate Kepco CK and ABC power supplies.

The VIX Relay Model VIX-1C translates the VIX REMOTE SIGNAL available on all CK and KS VIX equipped power supplies into a heavy duty relay closure for external application.

With these products and more, Kepco continues in one of its major aims which is to assist its customers with the application of power supplies to meet a wide range of problems. Thus, Kepco not only furnishes more and more applications engineering information but also many of the special devices needed to conveniently carry out these applications.

FLUX-O-TRAN NEW KEPCO TRADEMARK

Flux-O-Tran has been in use for some time by Kepco as a Trademark on their patented ferro-resonant line regulating transformer. This Trademark has now been registered in the U.S. Patent Office receiving Reg. No. 769,084.

MOTORIZED PROGRAMMER

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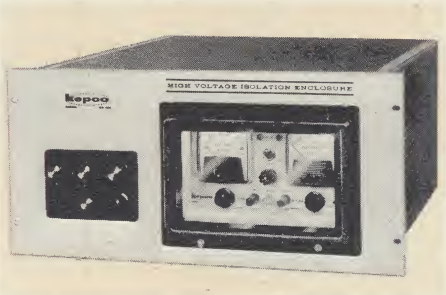
table, any desired portion of the potentiometer may be used. The period of a cycle of operation decreases in proportion to the decrease from full potentiometer range imposed by the setting of the stops.

HIGH VOLTAGE ISOLATION ENCLOSURE



High voltage isolation of regulated power is required in a number of applications. The most familiar would be to operate filaments or heaters of microwave tubes having grounded anodes. Complete isolation includes the provision of an AC line transformer with high voltage insulation between primary and secondary and insulation physically surrounding the power supply cabinet and controls. Only primary connections such as the primary on-off switch, fuses and pilot lamp may be mounted with only the usual low voltage insulation.

The Model 64 Isolation Enclosure has been designed to meet the need for a device in which standard regulated power supplies can be mounted to provide high voltage insulation and physical isolation. It consists in a rack mounting type of metal panel and dust cover containing high voltage stand-off insulators for supporting practically any "half rack" power supply. A high voltage insulated isolating transformer is mounted inside the enclosure to provide isolation between the AC circuit of the power supply and the AC line. A hinged plexiglass door on the front panel permits access to the power controls. An interlock switch on this door is provided for external use as, for example, to open a relay controlling the high voltage source of the system.

The Model 64 Isolation Enclosure has been designed particularly to accommodate any Kepco ABC or CK regulated power supply. The insulators for mounting the power supplies are adaptable to any of the various cabinet depths of these two series.

News TO THE PRESS

NEW KEPCO 52 PAGE CATALOG ANNOUNCED

More than a catalog, the new Kepco Catalog has been written and published to provide maximum usefulness in the selection and application of regulated power supplies. Instructions, definitions of terms and completely detailed specifications present a well rounded source of power supply information for the design engineer, buyer and user in understandable terms.

The specifying catalog includes multiple indexing. There is an index, tabulating all models according to their DESIGN GROUP with a corresponding list of output voltage and current. A second index lists all models according to OUTPUT VOLTAGE and CURRENT. This cross-indexing method has been found to save time and assist in selecting the best supply for a given purpose. All PROGRAMMABLE power supplies are additionally listed together with a summary of their programming characteristics. The specifying body of the catalog takes each design group and covers each model in detail completely delineating all electrical and mechanical characteristics together with all special features.

The ancillary information parts of the catalog include a glossary of power supply terms, general and special application instruction and information, a wire loss nomograph for calculating the voltage drop in load connecting wires, a VIX nomograph for rapid ohms law calculations of the load resistance, current and voltage relationship of automatic crossover power supplies.

Copies are available free from your local Kepco Engineering Representative or by writing to:

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